Spatial connectivity of Pacific insular species: Insights from modeling and tagging

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Certificate of Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree.

I also certify that this thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of candidate

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To all, *mahalo nui loa*

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Abstract

Animal movement was quantitatively investigated with computer simulation modeling and the analysis of animal-borne tagging data. Larval transport was simulated using advection-diffusion models driven by a variety of current fields. Seasonal, interannual, and spatial correlates of larval transport and retention were explored, as well as the effect of pelagic larval duration (PLD), using generalized additive modeling (GAM) analyses. Diel vertical migration (DVM) was simulated using layered current fields, and the effect on horizontal transport was examined over a range of PLDs, spawning locations, and spawning times. DVM was found to robustly facilitate natal retention in the simulations, using GAM analyses. Biogeographic transport routes linking Johnston Atoll and the Hawaiian Archipelago were elucidated using high-resolution current data and advection-diffusion models. The hypothesized transport routes were consistent with existing field survey data and genetic analyses. This connectivity has implications for both population maintenance and biogeographic affinities. Archipelagic connectivity was determined for all pairs of geographic strata in the region, and a simple metapopulation model was developed which was driven by the modeled linkages. Additionally, the flow fields used for the Johnston Atoll analysis and the archipelagic connectivity analysis were ground truthed with a drifter buoy database and found to be in good agreement. Conventional tags deployed on a deepwater snapper were examined to determine adult movement dynamics. Comparison to a simple model of swimming behavior suggested that biphasic swimming may be the characteristic swimming pattern for this species. Electronic tags deployed on sea turtles were used to characterize pelagic habitat in the North Pacific, using a suite of oceanographic and environmental data merged to the satellite tracks. Most of the analyses involved examination of a variety of remotely-sensed, modeled, or surveyed environmental data.